United States
Department of
Agriculture

Food Safety
and Inspection
Service

Science and
Technology

National Residue Program Plan 1994

SCIENCE AND TECHNOLOGY
FOOD SAFETY AND INSPECTION SERVICE

1994 NATIONAL RESIDUE PROGRAM PLAN

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PREFACE

A key aspect of food safety in the modern world is the control of residues in food that may result from the use of animal drugs and pesticides, or from incidents involving environmental contaminants. The United States has a complex residue control system, with rigorous processes for approval, sampling and testing, and enforcement. Three agencies play major roles in protecting the public from residues left in food by drugs, agricultural chemicals, and environmental contaminants. The Environmental Protection Agency (EPA) regulates pesticides that can be used in food production and other industrial chemicals that have the potential for contaminating food. EPA sets the tolerances for pesticides and other chemicals. The Food and Drug Administration (FDA) regulates and inspects foods other than meat and poultry and regulates animal feeds. FDA determines if drugs can be introduced into the market. This includes establishing tolerances for residues of animal drugs in edible tissues. The Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture is charged under the Federal Meat Inspection Act and the Poultry Products Inspection Act with ensuring that meat and poultry sold in interstate commerce in the U.S. is safe, wholesome, and free of adulterating residues.

National Residue Program

As part of its responsibilities, FSIS has since 1967 conducted the National Residue Program (NRP) to sample meat and poultry for residues. The NRP collects samples of meat and poultry at slaughtering establishments under its inspection authority and from import shipments at the ports of entry. The samples are analyzed for the presence of unacceptable residue concentrations of pesticides, animal drugs, and other potentially hazardous chemicals that may contaminate meat and poultry.

The goal of the NRP is to protect the consuming public from meat and poultry containing concentrations of residues that exceed the tolerances set by EPA and FDA. The specific objectives of the NRP are:

1. To assess and communicate the exposure potential from residues in the nation's meat and poultry supply.

2. To deter live animals with violative concentrations of residues in their tissues from being presented for slaughter.

3. To prevent edible tissues from slaughtered animals containing violative concentrations of residues from entering the food supply.

PREFACE

Purpose of Document

This document - now in its eleventh edition - details the activities of the Food Safety and Inspection Service (FSIS) in its evaluation of compounds that may be present in meat and poultry; it includes the 1994 NRP Plan. The document serves as a reference source for those concerned with food safety and with FSIS activities in that area. Please note that there have been extensive revisions for this edition.

Section 1

Section 1 is the NRP Plan for 1994, which describes domestic and import program activities. Section 1 includes a detailed Introduction, the compounds included in the plan, and tables showing the distribution of sampling activities.

Section 2

Section 2 is a list of tolerances and action levels for the compounds included in the 1994 NRP Plan.

Section 3

Section 3 defines the types of methods used by FSIS to conduct analyses and their suitability for regulatory use; defines key terms used to describe the methods; and lists the analytical methods for compounds included in the 1994 plan in alphabetical order.

Address for Comments

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Acknowledgements:

The editor is pleased to acknowledge the outstanding efforts of the following Science and Technology personnel:

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Section 1

Residue testing of animals slaughtered in the United States is divided into two major activities: population sampling programs (monitoring, exploratory, and surveillance), and individual enforcement testing.

Population Sampling Programs:

Monitoring, Exploratory, Surveillance

Monitoring and exploratory programs are used to detect a threshold level of residues in food animal populations or slaughter classes.

Monitoring involves the sampling of specified animal populations to provide profile information concerning the occurrence of residue violations on an annual, national basis. Compounds considered generally have established residue limits. They are selected based on risk profiles and the availability of laboratory methodology that is suitable for regulatory purposes. Information is obtained through a statistically-based random selection of specimens of normal -appearing tissue from passed carcasses. Generally, the number of specimens chosen provides a 95% probability of detecting at least one violation when one percent of the animal population is violative. In addition to profile information, the results are used to identify producers or other entities marketing animals with violative concentrations of residues. When such producers subsequently offer animals for slaughter, the animals will be subjected to individual enforcement testing until compliance is demonstrated. Since samples are randomly selected (statistically based) in the monitoring program, tissues from the same animals are analyzed for different compounds in some instances to make more efficiently use of resources. For example, antibiotics and sulfonamides are analyzed from tissues from the same animals. In these instances, samples tested do not equal the number of animals tested.

Exploratory programs are generally employed to study the occurrence of residues for which no residue limits have been established. There are many chemicals (e.g., trace metals, industrial chemicals, and mycotoxins) that may be inadvertently present in animals yet have no established residue limits. Their presence in edible tissues and the resulting need for residue limits to protect public health have not been established. FSIS may conduct studies to develop information on the frequency and concentrations at which such residues occur.

Surveillance is designed to distinguish components of the livestock and poultry population in which residue problems exist, to measure the extent of the problem, and to evaluate the impact of actions initiated to reduce the problem. In surveillance, the carcasses and organs may be retained pending test results.

Individual Enforcement Testing

Individual Enforcement Testing consists of analysis of specimens obtained from individual animals or lots based on signs or herd history. Testing is performed to detect individual animals with violative concentrations of residues. It is emphasized in problem

(high prevalence) populations and used as a tool to prevent residues from entering the food supply. Testing frequently results from decisions by program employees based on regional guidelines and direct observations. It is also used to follow up on producers and others who have been identified as marketing animals with violative concentrations or residues.

Domestic Quality Assurance

The Agency enters into "memoranda of understanding" with segments of the meat and poultry industry to provide assurance that when the animals are presented for slaughter they do not contain violative concentrations of chemical residues. This assurance is based both on reviewing records of critical control points in pre-slaughter management control programs and on residue testing in USDA-accredited laboratories. Because of this control and testing program at critical control points, these animals may be sampled under Quality Assurance sampling rather than under monitoring.

Import Program

Federal meat and poultry inspection laws require foreign countries exporting meat and poultry to the U.S. to impose inspection requirements at least equal to U.S. requirements. As part of the process for a foreign country satisfying the equal-to standard with respect to the U.S., the country must respond to a set of five questionnaires that are designed to obtain information regarding various risk areas. One of these risk areas is residues.

A critical process in the foreign inspection system is residue control and monitoring to ensure that chemicals or drugs prohibited in food animal production in the U.S. are controlled by foreign countries whose products are destined for the U.S. consumer. Present statutes require that foreign residue control programs include random sampling of animals at slaughter, the use of approved sampling and analytical methods, testing of the target tissue for specific compounds, and testing for compounds identified as potential contaminants of meat and poultry exported to the U.S. In addition, every foreign country must submit annual residue monitoring plans and results of the previous year's testing.

FSIS's International Programs (IP) evaluates foreign residue control programs through the on-site observation of the foreign country's inspection system, including exporting plants, equipment, and laboratories, and through actual sampling of imported product at the time of entry into the U.S. Import reinspection performed by FSIS inspectors located at various ports-of-entry around the country is a check on the effectiveness of foreign inspection systems; a component of the import reinspection process is residue sampling. To ensure that representative specimens are selected, a specimen is chosen at random from the lot selected for reinspection. The criteria for acceptance or rejection of imported products are the same as those applied to U.S. meat and poultry products prepared under Federal inspection. When test results indicate a violative level of residue in an imported product, every effort is made to locate and destroy any product already in U.S. distribution channels. Subsequent shipments of the same product from the same establishment are retained at the port-of-entry until laboratory results are known. If results are negative, product is

permitted to move into commerce; if positive, product is refused entry into the U.S. In addition, all shipments of like product from the country are placed on an increased testing schedule until a record of compliance is re-established.

Annual Plan

The development of the yearly NRP Plan begins in February of the preceding year and progresses by means of discussions, both formal and informal, among the Residue Evaluation and Planning Branches of the FSIS Science and Technology Program, other Science and Technology Divisions, other FSIS programs, and involved Federal Agencies; it culminates in formal reviews by FSIS and an interagency working group during the late summer and fall. The plan is based on a "residue/species pair" design concept. The species or production-class groups paired with residues are determined by commonalities in rearing as these factors affect the animal's exposure and the probability that residues may be present at slaughter. For example, market hogs have an exposure-potential profile different from that of boars and sows.

In 1983 FSIS asked the Food and Nutrition Board of the National Research Council (NRC) to evaluate the scientific basis of the present system for inspecting meat and poultry and meat and poultry products and to assess the National Residue Program. The NRC report *Meat and Poultry Inspection: The Scientific Basis of the Nation's Program*, published in 1985, contained a number of recommendations and described the characteristics of an ideal program. During fiscal year 1986, FSIS considered the mission and design of the residue program in terms of the NRC report. This review influenced portions of the 1986 plan and has had an additional impact on the plans from 1987 through 1994.

Although the projections upon which the plan is based are as exact as possible, they may not match budgetary or facility resources, or specific sampling and analytical capabilities or requirements during 1994. Residue control is a dynamic field, with continual change; the plan will be modified during the year as additional information alters the original assessment.

Criteria for Compound Evaluation and Ranking

There are several hundred pesticides registered for use in the United States; pesticide residues may also occur in meat and poultry as the result of environmental contamination. The number of potential residues from animal drugs is equally impressive. It is not necessary, however, to monitor for residues of all chemicals, since they differ greatly in ability to produce a residue, degree of hazard to health, and potential for exposing the human population to their residues. In deciding where available resources and testing efforts should be assigned, FSIS must assess relative concerns for those residues most likely to have the greatest impact on public health. Similarly, the allocation of research and development resources must be based on an evaluation of the public health hazard.

For purposes of developing and managing the NRP, residues are given precedence using a risk assessment procedure, the Compound Evaluation System (CES), developed in

1985. The CES has three key elements, the first being whether the compound produces a residue. If so, the second CES factor is hazard, and the third is exposure.

There are two ways in which FSIS can predict the likelihood of a residue occurring. For one, many compounds have tolerances established by the FDA or EPA. Secondly, assessment of the pharmacokinetic properties of a compound - the rates of absorption, excretion, and tissue distribution - may be obtained from the literature.

Each compound is evaluated for its potential to produce residues in meat or poultry, using the following criteria to exclude a compound from further consideration:

1. There is a zero-day withdrawal period established by FDA or EPA.

2. The compound is biodegraded rapidly to non-toxic products.

3. The compound is not absorbed, or if absorbed, is excreted rapidly.

4. The specific compound and its metabolites are physically unstable in the environment.

The second element, hazard, refers strictly to the inherent toxicity of a compound; primary emphasis is given to residues producing life-threatening, irreversible, or severely debilitating toxic effects. Special attention is focused on chronic toxic effects, i.e., whether a residue is a mutagen, carcinogen, reproductive toxin, or teratogen since the amount of a compound needed to produce acutely toxic effects is not liable to occur in meat. Toxicologic effects - e.g., site-specific organ toxicity, immunotoxicity, and hematoxicity - are also considered in assessing the overall hazard potential of a compound.

In order to make it easier to evaluate critical toxic effects, a toxicological profile format was developed. Information summarized in this format includes findings from both clinical investigations and laboratory studies. If available, clinical observations from well-documented medical or epidemiologic investigations of exposed humans are invaluable in classifying the hazard potential posed by a substance, especially with oral exposure.

With these considerations in mind, appropriate data (largely from laboratory animals) are entered in the toxicologic profile and brief summaries of the toxic effect are prepared. Finally, an overall conclusion is reached regarding the potential hazard posed by the compound under review. This includes assigning the compound to one of five hazard categories: A, B, C, D, or Z. The hazard categories range from A: high health hazard potential and B: moderate health hazard potential, to C: low health hazard potential and D: negligible health hazard potential. Z is assigned to compounds for which there is insufficient information available to conduct an adequate toxicologic or pharmacologic evaluation.

The third element of the compound evaluation system is exposure characterization (EC). Its purpose is to assess the factors that will significantly influence the likelihood of human exposure to chemical residues of pesticides, animal drugs, or other contaminants occur-

ring in meat or poultry in concentrations that may affect human health. For most chemical residues that may occur in meat or poultry, the concentrations are low enough that, with few exceptions, adverse health effects are unlikely to occur from single or very infrequent exposures.

There are many factors known to affect the occurrence of chemical residues in meat. These include, among others, the nature or extent of actual or probable use, metabolic patterns of a given chemical in animals and plants, persistence in tissues or the environment, and the potential for deliberate or unintentional misuse.

An exposure characterization checklist was constructed for use by FSIS reviewers in order to provide a measure of uniformity and standardization in the evaluation of the many variables known to affect the probability of a chemical residue occurring in meat and poultry. After appropriate information has been entered in the EC checklist, the total profile is then evaluated and a decision made regarding the probability of a specific residue occurring in meat or poultry in concentrations that may be significant for human health. Inherent in this decision process is reliance upon scientific judgment, especially in circumstances where data limitations do not permit a well-documented exposure characterization.

Based on an evaluation of information in the EC checklist, the compound under consideration is assigned to one of five exposure categories, ranging from 1: high probability of exposure and 2: moderate probability of exposure to 3: low probability of exposure and 4: negligible probability of exposure. Category Z designates a substance with insufficient information available to estimate the probability of exposure of humans to a toxic concentration from meat or poultry.

After a pesticide, animal drug, or environmental contaminant has been determined to produce a residue (Element I), evaluated according to hazard potential (Element II), and probability of exposure to a residue (Element III), the compound is assigned an overall two-tiered ranking in a matrix.

This dual ranking system results in the classification of a given chemical in one of 24 categories. Compounds of greatest concern are designated A-1: high health hazard potential/high likelihood of residue occurrence; compounds of least significance are designated D-4: negligible health hazard potential/negligible likelihood of residue occurrence. Compounds that are not ranked under the CES are marked in this document as NR, for Not Ranked. (Note: The CES alphanumeric ranking is unrelated to EPA's A-B-C-D hazard identification system.) In the construction of the compound evaluation system, care was taken to avoid the use of exact numerical rankings that could suggest a high degree of precision possibly not justified because of data limitations or assumptions inherent in the ranking process.

In summary, the basic approach to compound ranking consists of three elements:

1. Determining if a compound can cause a residue; If the answer is Yes, then,

2. Assessing the hazard of the compound, and

3. Assessing the potential for human exposure resulting from occurrence in meat or poultry.

The Agency's ongoing evaluation of information for compound ranking is aided by an advisory board of scientists from EPA, FDA, and USDA (FSIS and the Agricultural Marketing Service). This advisory relationship is defined in a Memorandum of Understanding between the three agencies (Federal Register, January 16, 1985).

Compounds are included in the NRP Monitoring Plan according to certain guidelines. A compound initially included in the NRP Monitoring Plan must leave a detectable residue(s) in meat and poultry, and have an established tolerance, action level, or other regulatory limit. In most cases, it will have received a CES ranking. FSIS laboratories must possess a suitable regulatory method, validated as capable of confirming the identity and pertinent quantity of the residue. If a multi-residue method detects compounds not of concern for the current program, the residue will be reported as a violation and appropriate regulatory action will ensue. The NRP Monitoring Plan usually comprises compounds with CES ranking of A1, A2, A3, B1, B2, or C1; these compounds are termed Monitoring Plan Compounds.

Decision Criteria for Including and Cycling Chemical Compounds

Chemical compounds are included in or cycled out of the NRP Monitoring Plan as follows:

I. Compounds included in the NRP Monitoring Plan for the first time

a. The Residue Evaluation and Planning Division uses a number of sources to identify compounds of concern. The concern is based on hazard and potential frequency of occurrence. The latter excludes compounds that result from infrequent, unpredictable events.

b. Initial requirements for inclusion in the NRP Monitoring Plan are: first, the compound leaves a detectable residue(s) in meat and poultry; second, a tolerance is established or an action level or other regulatory limit is recommended by the EPA, FDA, or USDA; and third, the compound has a CES ranking.

c. A Monitoring Plan compound is included in the NRP when a regulatory method is available in FSIS laboratories. If a multi-residue method is used and it detects compounds that are above tolerance and are not listed in the NRP Monitoring Plan, the residue will be reported as a violation and appropriate regulatory action will ensue.

II. Compounds cycled out of the NRP Monitoring Plan

A compound is cycled out of the NRP Monitoring Plan when its risk characterization changes (this includes both the hazard and/or exposure elements) to other than a Monitoring Plan Compound.

a. Changes in the hazard classification, although rare, may occur and may have an impact on our degree of concern.

b. The exposure potential, i.e., the CES's exposure characterization, is the risk assessment element most subject to change. Therefore, available sources of information are periodically reviewed. The NRP laboratory testing results are routinely reviewed and the yearly summary is reviewed as soon as the data become available to update each compound's exposure potential. Indications of changes in exposure potential are:

1. The approval for the use of a compound is withdrawn by EPA or FDA. However, a compound may continue to have exposure potential because of continued use of stockpiles or persistence in the environment.

2. Discontinued use of a compound by industry.

Whenever there are no violative NRP Monitoring Plan laboratory results after 3 consecutive years of testing, the compound is a candidate to be cycled out.

III. Compounds cycled back into the NRP Monitoring Plan

The exposure potential of compounds that have been cycled out of the NRP Monitoring Plan is evaluated annually. When evidence indicates an increase in exposure potential, the compound is considered for cycling back into the NRP Monitoring Plan.

IV. Compounds of interest not meeting all the above criteria for monitoring

At times information is desirable on potential occurrence of residues for those compounds with significant exposure potential but lacking an official tolerance or other regulatory limit. In those cases the compound may be included in an exploratory phase of the NRP if suitable reliable methodology is available.

If residues are detected for these compounds, FDA or EPA would be notified and a request made for a regulatory limit so that the compound could be included in NRP monitoring.

Over the past ten years, virtually all the residues for which suitable methods were available have been monitored, except for compounds with especially low rankings.

Summary

In 1993 FSIS planned to conduct 386,938 analyes for residues from eleven compounds or compound classes. During 1994 the NRP plans 430,708 analyses for residues from twelve compounds or compound classes.

Annual Plan Tables

The following describes the tables in which the details of the plan are presented. Preceding the tables is an alphabetical list (with explanatory material) of the compounds included in the 1994 plan.

Table I (1.15 - 1.19)

Table I is a list of compounds in the 1994 Plan. CFR reference names, where available, are used for the primary entries; common names are given in square brackets, where applicable. Metabolites are listed with the parent compounds. Complex mixtures such as PCB's are listed as a single entry. CES ranking is an alphanumeric system consisting of two parts that express the risk assessment of a compound. Residue codes are used in the data base to identify specific compounds. The column labeled "In NRP Monitoring Plan" provides historical information given in a separate section of earlier editions.

Table II (1.20)

The number of specimens for a given residue/species pair generally is chosen to ensure detection of a problem that affects a specified percentage of the population. Table II shows the relationship among the specimen size required to detect a problem, the size of the problem, and the probability of detection. The number of specimens generally is chosen to provide a 95% probability of detecting at least one violation when one percent of the animal population is violative. This requires approximately 300 specimens. Ensuring a 95% probability of detecting a problem that affects 0.1 percent of the sampled population would require increasing the number of specimens to approximately 3,000. When it is known or anticipated that a residue presents a significant public health problem, sampling may be increased. The increased sampling permits study of trends and geographic or seasonal variation in violation rates, and may aid in preparing effective control actions. The sample units do not equal the number of animals tested.

Conversely, specimen sets of fewer than 300 specimens are appropriate when at least one of the following conditions pertains: a minor species is involved; it is known that the prevalence of residues in the species involved is low or apparently nonexistent; slaughter of the species occurs in only a few establishments; cost savings or more urgent demands necessitate the reduction of sampling or laboratory resources.

Collection requests for specimens are generated monthly, using an FSIS computerized system in Washington, D.C. Specimen and plant selection is random and statistically (probability) based by production class, with a minimal bias. Normally, residues are

monitored for the entire year, but some may be introduced during the year and may continue into the following year. Others may be included only during a particular period of the year. Variables such as production volume, geography, and season are addressed statistically within resource constraints. In some cases where method development is incomplete, specimens will be collected on a monthly basis but analytical work may be delayed until the methods are implemented.

Table III (1.21 - 1.23)

Table III lists the species/classes to be sampled and their identifying code numbers and the tissues and specimen amounts to be collected for analysis.

Table IV (1.24)

Table IV presents a summary of the combined domestic and import plans. The plans specify the specimen units planned for analysis. In the domestic program a livestock specimen unit represents one animal. With poultry, a specimen unit can be from one animal when the target tissue is a large one such as fat or muscle or the liver in turkeys. In some cases, the target tissue, such as the liver in chicken, is too small to produce an adequate specimen. A poultry specimen is usually a composite from six birds.

Table V (1.25)

In themselves, specimen numbers are not good indicators of the actual commitment of resources, or of the effectiveness of these commitments. Table V illustrates the wide divergence among test procedures in amount of analyst time required per specimen.

Table VI (1.26 -1.27)

Table VI presents the domestic program specimen units planned for 1994, including monitoring, surveillance, and individual enforcement testing. The laboratory analyses shown under surveillance and individual enforcement testing are generally additional analyses of specimens that have been tested in-plant; they are usually conducted on tissues other than those tested in-plant and are thus presented here as separate analyses.

Tables VII-VIII (1.28 - 1.29)

Tables VII and VIII show the monitoring specimen units planned for domestic livestock, and poultry and rabbits, respectively. The specimen unit numbers for each residue designation are presented according to species or production class. (Note that, beginning with this table, totals are given directly under the compound or country.)

Table IX (1.30)

Table IX presents the sampling plan for imported products. The design of the import plan differs from the domestic plan because it involves the reinspection of product that has already been inspected under an approved foreign system with a residue program equal to that of the U.S. Thus port-of-entry residue sampling is intended to provide further information on the operation of the foreign system's residue controls.

The import inspection program uses an Automated Import Information System (AIIS) to direct the selection of specimens from any port where product may arrive. Data stored in the AIIS are used for monthly updates of the sampling requirements for each country, product, and residue class, to ensure that the commitments of the annual plan are met. Appropriate changes can be made in the AIIS if, during the course of the year, there are unexpected changes in the volume or type of imported product from any country or countries.

Table X (1.31 - 1.34)

Table X shows the planned import specimens by species and by country.

Tables XI-XXI (1.35 - 1.45)

Table XI (1.35) shows the estimated annual volume of imported beef, divided into fresh (including frozen) and cured/cooked products. Table XII (1.36 -1.37) lists the specimen unit analyses planned for fresh and cooked/cured beef products. Tables XIII (1.38) and XIV (1.39-1.40) follow the same procedure for imported pork; Table XV (1.41) for beef/pork processed products; Tables XVI (1.42) and XVII (1.43) for fresh veal and mutton/lamb; Tables XVIII and XIX (1.44) for goat and chicken; and Tables XX and XXI (1.45) for turkey and duck/goose/guinea fowl.

Compounds Included in the 1994 National Residue Program Plan

Antibiotics

During the last decade antibiotic use in food animals, as in human medicine, has been increasingly directed against specific conditions and less toward general therapy or disease prevention. Nevertheless, some antibiotics continue to be fed at subtherapeutic concentrations to enhance feed efficiency and promote growth.

The antibiotics vary widely in their toxicity, safe residue concentrations, and required withdrawal periods. Toxic effects include, for example, life-threatening hypersensitivity responses (penicillins) and hearing impairment (streptomycins). In addition, there is concern about the development and transmission of pathogenic organisms resistant to antibiotic therapy.

The residue designation "penicillins" comprises other compounds that can be detected but not identified, as the current FSIS laboratory methodology cannot distinguish between members of the beta lactam family of compounds, which includes penicillins, amoxicillin, ampicillin, and cloxacillin. The residue designation "streptomycin" is a similar case in that positive streptomycin results may represent unidentifiable residues of dihydrostreptomycin. It should be noted that chloramphenicol was monitored in some past years by a separate method and thus was not listed with the antibiotics class, but the antibiotics methods have always been capable of detecting and identifying chloramphenicol. Accordingly, the compound has been added to the antibiotics class.

Calves have presented a high percentage of violative antibiotic residues. Until 1988, calves were sampled as a single class. Since 1988 calves have been divided into four groups: bob calves (up to 3 weeks of age or 150 pounds in weight); formula-fed calves between 150 and 400 pounds; non-formula calves between 150 and 400 pounds; and heavy calves (over 400 pounds). Formula-fed calves are a problem because they are slaughtered at three or four months. Consequently, they may retain residues of some long-acting antibiotics in their kidneys or other tissues. Bob calves present an acute problem, as they are slaughtered before many drugs that might be administered can deplete to safe concentrations. FSIS conducts an intensive in-plant testing program - the Calf Antibiotic and Sulfonamide Test (CAST) program - directed at violative antibiotic and sulfonamide residues in bob calves.

Cows presented for slaughter are usually culled from beef or dairy herds for substandard performance and may have been treated before slaughter. Consequently, cows also have had a relatively high percentage of violative residues. FSIS has an in-plant testing program for cows suspected of containing violative residues - the Swab Test on Premises (STOP) program - that has been effective over the years in reducing the previously very high violation rate in this vulnerable group of animals. Carcasses that are STOP-positive will be retained pending confirmation of adulteration by laboratory analysis. Before 1989 both beef and dairy cows were grouped together with bulls as a single production class; since 1991 dairy cows have been sampled separately from beef cows.

In 1991 the Agency developed the Fast Antimicrobial Screen Test (FAST), which detects both antibiotic and sulfonamide drug residues in livers and kidneys within six hours and has been proved to be a suitable replacement for CAST and STOP. Not only is the new test faster - six instead of 18 hours - but it can be read more easily because a dye creates a purple zone of inhibition that can be seen at a glance. FSIS plans to gradually phase it in during 1994.

For a number of years, the market hog slaughter class has been identified as a problem population for antibiotic violations. A special surveillance program in 1994 will sample market hogs in an attempt to determine the cause of this problem.

All fresh imported product will be sampled and tested for antibiotics in 1994.

Sulfonamides

Sulfonamides are bacterial and protozoal suppressant drugs that have been widely used in animals and humans since the early 1940's. They continue to be popular because of their economic advantages and wide spectrum of activity. Toxic effects include renal damage, thyroid damages, and allergic reactions.

For a number of years, the market hog slaughter class has been identified as a problem population for sulfonamide violations. A special surveillance program in 1994 will sample market hogs in an attempt to determine the cause of this problem.

Domestic monitoring specimens are planned for 1994 in all species/production groups. In the import plan, all commodities will be sampled for sulfonamide testing.

Arsenicals

Organic arsenical compounds, either alone or combined with other compounds, have been widely used both in humans and in food-producing animals as tonics, restoratives, herbicides, pesticides, protozoal and helminthologic agents, antimicrobials, and growth promoters. Members of the arsenical family of compounds include arsenic, arsenite sodium, arsanilate sodium, arsanilic acid, and cacodylic acid. They are approved for use in poultry as growth promoters and, in conjunction with other compounds, as coccidiostats; they are used in swine as growth promoters and to prevent bacterial enteritis.

When arsenicals are used as approved in chickens and swine, the animals or birds must not be treated with or exposed to the arsenical compounds within five days of slaughter. This five-day withdrawal period is sufficient to ensure that concentrations of arsenic in the tissues are lower than the tolerance concentrations.

Inorganic arsenicals have been linked to skin, lung, and liver cancer. The organic arsenical compounds used in food animal production do not seem to have carcinogenic or irritant effects. Arsenic analyses in FSIS laboratories can detect and quantify arsenic residues resulting from both drug and pesticide use, but cannot distinguish between the different sources. Thus, the residue concentrations reported may be the result of background, contaminants, drugs, or pesticide exposure of the animal. Because the source of arsenic residues cannot be identified by laboratory analysis, we must assume that a residue in cattle, swine, chickens, turkeys, or horses has resulted from an approved or registered use of the compound. Concentrations above tolerance would be in violation. Analytical results are reported as elemental arsenic. Tolerances expressed as As_2O_3 must be converted to elemental arsenic for consistency in analyzing data.

Carbadox

Carbadox is approved for use in swine weighing less than 75 pounds to prevent or treat enteritis and for increased feed efficiency and weight gain. The last exposure of swine to

carbadox must be at least 10 weeks before slaughter. The parent compound is a liver carcinogen.

Chlorinated Hydrocarbons and Organophosphates (CHC/COP's)

FSIS laboratories use multi-residue and confirmatory analytical procedures that can identify as violative a number of chlorinated hydrocarbons. In 1987 the chlorinated hydrocarbon method was modified slightly to include residues in fat from a group of chlorinated organophosphates.

Many of the chlorinated hydrocarbons are potent and persistent pesticides the use of which has been discontinued or severely restricted because of concerns regarding mutagenciity, carcinogenicity, hazard to wildlife, and bioaccumulation. Accumulation of chlorinated hydrocarbons in body fat may result in concentrations 10 to 30 times as great as in the food supply. Metabolism and excretion are slow, and the biological half-life of these compounds may be several months in mammals and several years in arid soils. Their persistence and potency make them effective long-term pesticides but also cause their continuing though diminishing occurrence as residues in meat and poultry products.

During 1994 analyses are planned for all domestic and imported species and production classes.

Halofuginone

Halofuginone is a coccidiostat for young chickens and young turkeys. In higher doses halofuginone is a growth depressant, impairs feed utilization, and reduces feed intake. In rats it causes alopecia. The compound is prohibited from use during the last four days before slaughter.

Ivermectin

Ivermectin is a macrocyclic lactose compound active at extremely low doses against a wide variety of nematode and arthropod parasites. Ivermectin is teratogenic in the rat, rabbit, and mouse.

Levamisole

Levamisole is a broad-spectrum anthelmintic that is active against the mature stages of the major gastrointestinal helminths and against mature and immature lung worms. It is approved for use in swine, non-lactating dairy cattle, and beef cattle. Withdrawal times vary from two to nineteen days before slaughter depending on the species and dosage regimen.

Morantel Tartrate

Morantel tartrate is a broad-spectrum anthelmintic used for the removal and control of mature gastrointestinal nematode infections. It is approved for use in dairy and beef cattle. The frequent use of morantel tartrate in dairy cattle was a major factor for including this compound in the plan. The chemical method used to determine the presence of morantel tartrate will also detect pyrantel, an anthelmintic that is approved for use in swine and horses.

Exploratory Projects

Alachlor

Alachlor is a pre-emergent herbicide used to control annual grasses and certain broad leaf weeds, in corn, dry beans, peanuts, and soya beans. It is one of the most commonly used herbicides in the U.S. It is listed as an exploratory project because the current analytical method used to detect its presence is a nonvalidated method.

Clenbuterol

Clenbuterol is a beta agonist used in some other countries to treat respiratory conditions in race horses and to prevent premature uterine contractions in pregnant cattle. It has not been approved by FDA for use in the United States. Although not approved for use in the United States, clenbuterol may be used illegally in some livestock show circles to increase the muscle mass of animals.

The clenbuterol exploratory project will incorporate a two-phase plan. The first phase will sample from the general populations of heavy calves, heifers, steers, market hogs, formula-fed calves, and lambs. The second part of this plan will sample from show animal populations of heifers, steers, market hogs, sheep, and lambs.

Diminazene Aceturate (Berenil)

Berenil is an aromatic diamidine that is used to treat trypanosomiasis and babesiosis, which are caused by parasites living in the blood stream of several species of animals. It has not been approved by FDA for use in the United States. Although not approved for use in the U.S., Berenil may be used illegally in cattle in Puerto Rico.

TABLE I: LIST OF COMPOUNDS IN THE 1994 PLAN

Compounds/ Products	Reference	CES Ranking	Residue Code	In NRP Monitoring Plan
ANTIBIOTICS				
Chloramphenicol	21 CFR 520.390	A-2	203	1981-93
Chlortetracycline	21 CFR 556.150 21 CFR 558.128	B-2	209	1972-93
Erythromycin	21 CFR 556.230 21 CFR 526.820 21 CFR 558.248 21 CFR 520.823	NR	206	1972-93
Gentamicin sulfate	21 CFR 556.300 21 CFR 520.1044 21 CFR 522.1044 21 CFR 524.1044 21 CFR 529.1044	B-2	211	1984-93
Neomycin sulfate	21 CFR 556.430 21 CFR 522.1484 21 CFR 524.1484	B-3	207	1972-93
Oxytetracycline hydrochloride	21 CFR522.1662 21 CFR 556.500	B-2	208	1972-93
Penicillins[1]	21 CFR 556.510 21 CFR 558.460 21 CFR 522.1696	A-2	201	1972-93
Streptomycin[2]	21 CFR 566.610 21 CFR 520.2158 40 CFR 180.245	A-3	202	1972-93
Tetracycline hydrochloride	21 CFR 556.720 21 CFR 520.2345	A-1	204	1977-93

1. "Penicillin" results may consist of unidentifiable quantities of amoxicillin, ampicillin, and cloxacillin.
2. "Streptomycin" results may represent unidentifiable quantities of dihydrostreptomycin.

TABLE I: LIST OF COMPOUNDS IN THE 1994 PLAN

Compounds/ Products	Reference	CES Ranking	Residue Code	In NRP Monitoring Plan
ANTIBIOTICS, continued				
Tylosin	21 CFR 556.740 21 CFR 520.2640 21 CFR 522.2640 21 CFR 524.2640 21 CFR 558.625	D-2	205	1985-93
SULFONAMIDES				
Sulfachlorpyridazine	21 CFR 556.630 21 CFR 520.2200 21 CFR 522.2200	NR	802	1984-93
Sulfadimethoxine	21 CFR 556.640 21 CFR 520.2220 21 CFR 522.2220 21 CFR 558.575	A-3	803	1973-93
Sulfaethoxypyridazine	21 CFR 556.650 21 CFR 520.2240 21 CFR 522.2240 21 CFR 558.579	NR	801	1984-93
Sulfamethazine	21 CFR 556.670 21 CFR 520.2260 21 CFR 522.2260	B-1	805	1973-93
Sulfaquinoxaline	21 CFR 520.2325	B-1	810	1973-93
Sulfathiazole	21 CFR 556.690	B-1	809	1973-93

TABLE I: LIST OF COMPOUNDS IN THE 1994 PLAN

Compounds/ Products	Reference	CES Ranking	Residue Code	In NRP Monitoring Plan
ALACHLOR[1]	40 CFR 180.249	A-2	725	NA
ARSENICALS				
Arsenic[2]	21 CFR 556.60	NR	401	1972-93
CARBADOX	21 CFR 556.100	A-3	907	1973-84 1987-93
CHLORINATED HYDROCARBONS & ORGANOPHOSPHATES (CHC/COP'S)				
Aldrin	51 FR 46662[3]	A-3	101	1972-93
Benzene Hexachloride [BHC]	51 FR 256972	B-2	102	1972-93
Carbophenothion	40 CFR 180.156	NR	318	1981-82,85-86,88-93
Chlordane	None	A-2	103	1972-93
Chlordecone [kepone]	None	NR	150	1988-93
2-Chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphates [chlorfenvinphos]	40 CFR 180.322	NR	320	1988-93
2-Chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate [stirofos]	40 CFR 180.252	NR	314	1973-79, 1985-93

1. Exploratory project.
2. "Arsenic" results may represent unidentifiable quantities of arsenite sodium, arsanilate sodium, arsanilic acid, and cacodylic acid.
3. Tolerances revoked December 24, 1986.

TABLE I: LIST OF COMPOUNDS IN THE 1994 PLAN

Compounds/ Products	Reference	CES Ranking	Residue Code	In NRP Monitoring Plan
CHLORINATED HYDROCARBONS & ORGANOPHOSPHATES (CHC/COP'S) continued				
Chlorpyrifos and metabolites	40 CFR 180.342	B-4	315	1972-76,78,80-83 1985-93
Coumaphos and oxygen analog	40 CFR 180.189	B-2	362	1972-76,78, 1980-93
DDT and metabolites[1]	51 FR 46658	B-3	105	1972-93
Dieldrin	51 FR 466621	NR	104	1972-93
Dodecachloroocta-hydro-1,3,4-metheno-2H-cyclobuta(cd)pentalene [Mirex][2]	51 FR 451143	A-4	113	1972-93
Endosulfan and metabolite	40 CFR 180.182	NR	152	1988-93
Endrin	40 CFR 180.131	A-3	106	1972-93
Heptachlor and heptachlor epoxide	54 FR 33690	A-1	107	1972-93
Hexachlorobenzene [HCB]	None	A-3	112	1972-93
Lindane	40 CFR 180.133	A-2	108	1972-93
Linuron	40 CFR 180.184	A-3	153	1988-93

1. Tolerances revoked December 24, 1986.
2. Tolerances revoked December 17, 1986.

TABLE I: LIST OF COMPOUNDS IN THE 1994 PLAN

Compounds/ Products	Reference	CES Ranking	Residue Code	In NRP Monitoring Plan
CHLORINATED HYDROCARBONS & ORGANOPHOSPHATES (CHC/COP'S), continued				
Methoxychlor	40 CFR 180.120	D-4	109	1972-93
Phosalone	40 CFR 180.263	NR	154	1988-93
Polychlorinated biphenyls [PCB's]	21 CFR 109.30 46 FR 39224	A-4	111	1972-93
Ronnel	40 CFR 180.177 21 CFR 558.525 21 CFR 520.2080	NR	307	1972-76,78 1980-83 1985-93
CLENBUTEROL[1]	None	B-4	561	NA
DIMINAZENE ACETURATE [BERENIL][1]	None	NR	965	NA
HALOFUGINONE	21 CFR 556.308 21 CFR 558.265	A-1	926	1986-93
IVERMECTIN	21 CFR 556.344 21 CFR 520.1192, 3,4,5,6 21 CFR 522.1192,1193	B-1	923	1984-93
LEVAMISOLE	21 CFR 556.350	C-2	910	1984,86 1993
MORANTEL TARTRATE	21 CFR 556.425 21 CFR 558.360	B-4	921	1983,84,85 1993

1. Exploratory project.

TABLE II: Number of Specimens Required to Ensure Detection of a Problem that Affects a Given Percentage of the Sampled Population

Percentage Violative in Sampled Population	Probability of Detection (Percent)			
	90	95	99	99.9
	Specimens Required			
10	22	29	44	66
5	45	59	90	135
1	230	299	459	688
0.5	460	598	919	1,379
0.1	2,302	2,995	4,603	6,905
0.05	4,605	5,990	9,209	13,813

TABLE III. Target Tissues to be Collected for Analysis in 1994

SPECIES	SPECIES CODE	SPECIES	SPECIES CODE	SPECIES	SPECIES CODE
Horses	01	Non-formula	23	Roaster Pigs	54
Bulls	11	Heavy Calves	24	Y. Chickens	61
Beef Cows	13	Sheep	31	M. Chickens	63
Dairy Cows	15	Lambs	32	Y. Turkeys	72
Heifers	14	Goats	40	M. Turkeys	73
Steers	12	Market Hogs	51	Ducks	81
Bob Calves	21	Boars	52	Geese	82
Formula-fed	22	Sows	53	Rabbits	91

Compound	Residue Code	Substrate Analyzed[1]	Tissue Code	Species Code	Red Meat Animal[2]	Poultry[3]/ Rabbits[3]
ANTIBIOTICS						
	200 Series	**Liver**[4]	02	All	**One Pound**	**Whole liver**
		Muscle[4]	03			**One-fourth pound**
		Kidney	04			**both kidneys**
SULFONAMIDES						
	800 Series	Urine[5]	D3		10 ml.	
		Liver[5]	02	All	**One Pound**	**Whole liver**
		Muscle[5]	03	All	**One Pound**	**One-fourth pound**

1 Tissues in **bold-face type** submitted for monitoring samples; for surveillance samples, all tissues submitted.

2 Collect from each red meat animal and pack each tissue separately.

3 Collect from each of six birds/rabbits and pack each tissue separately.

4 Liver to be analyzed if kidney is violative; muscle to be analyzed if liver is violative.

5 Urine is sampled for in-plant SOS testing only; if liver is violative, then muscle is analyzed.

TABLE III. Target Tissues to be Collected for Analysis in 1994, continued

Compound	Residue Code	Substrate Analyzed[1]	Tissue Code	Species Code	Red Meat Animal[2]	Poultry[3]/ Rabbits[3]
Alachlor						
Exploratory only	725	Liver	02	11,12, 13,14, 15	One pound	
Arsenicals						
	401	**Liver**	02	40,51,	**One pound**	**Whole**
		Muscle	03	52,53, 61,63, 72,73	One pound	**Liver** One-fourth pound
Carbadox						
Surveillance only	907	Liver	02	54	One pound	
		Muscle	03		One pound	
Chlorinated Hydrocarbons & Organophosphates (CHC/COP's)						
	100/300 series	**Fat**	01	All except 21	**One pound**	**One-fourth pound**
Clenbuterol						
Exploratory only	561	Liver	02	12,14,	One pound	
		Urine	D3	24,30, 32,48*, 51	30 ml	

1 Tissues in **bold-face type** submitted for monitoring samples; for surveillance samples, all tissues submitted.

2 Collect from each red meat animal and pack each tissue separately.

3 Collect from each of six birds/rabbits and pack each tissue separately.

*Show animal

TABLE III. Target Tissues to be Collected for Analysis in 1994, continued

Compound	Residue Code	Substrate Analyzed[1]	Tissue Code	Species Code	Red Meat Animal[2]	Poultry[3]/ Rabbits[3]
Diminazene Aceturate (Berenil)						
Exploratory only	965	Blood Plasma	C3	11,12, 13,14, 15,24	10 ml., Use Heparin as an anticoagulant and submit plasma to the lab	
Halofuginone						
	926	**Liver**	02	61,72		**Whole liver**
		Muscle	03			One-fourth pound
Ivermectin						
	923	**Liver**	02	All	**One pound**	
		Muscle	03	except 11	One pound	
Levamisole						
	910	**Liver**	02	All	**One pound**	
		Muscle[4]	03	except	**One pound**	
		Kidney	04	21,23	**One pound**	
Morantel Tartrate	921	**Liver**	02	11,12, 13,14, 15,22,23,24	**One pound**	

1 Tissues in **bold-face type** submitted for monitoring samples; for surveillance samples, all tissues submitted.

2 Collect from each red meat animal and pack each tissue separately.

3 Collect from each of six birds/rabbits and pack each tissue separately.

4 Muscle to be analyzed if liver is violative.

TABLE IV: 1994 Domestic and Import Specimen Unit Analyses

	Domestic	Import
Antibiotics Total: 20,578	17,510	3,068
Sulfonamides Total: 24,629	17,330	7,299
Alachlor* Total: 1,500	1,500	-
Arsenic Total: 3,455	2,400	1,055
Carbadox Total: 800	800	-
Chlorinated Hydrocarbons and Organophosphates [CHC/COP's] Total: 14,403	9,410	4,993
Clenbuterol* Total: 1,900	1,900	-
Diminazene Aceturate [Berenil]* Total: 1,670	1,670	-
Halofuginone Total: 822	600	222
Ivermectin Total: 5,819	3,900	1,919
Levamisole Total: 5,212	3,900	1,312
Morantel tartrate Total: 3,031	2,400	631
Totals **Sum Total: 83,819**	**63,320**	**20,499**

*Exploratory project

TABLE V: 1994 Domestic and Import Specimen Unit Laboratory Analyses

Residue Designation	Total Specimen Unit Lab Analyses	Estimated Lab Time Per Analysis (Hours)	Estimated Total LabTime (X100 Hours)
Antibiotics	20,578	0.55	113.18
Sulfonamides	24,629	0.95	233.98
Alachlor*	1,500	*	*
Arsenic	3,455	0.51	17.62
Carbadox	800	2.00	16.00
CHC/COP's	14,403	1.00	144.03
Clenbuterol*	1,900	*	*
Diminazene Aceturate* (Berenil)	1,670	*	*
Halofuginone	822	2.70	22.19
Ivermectin	5,819	1.15	66.92
Levamisole	5,212	1.20	62.54
Morantel tartrate	3,031	1.11	33.64
Totals	**83,819**		**710.10**

* Exploratory project - new method; laboratory time estimate not available yet.

TABLE VI: 1994 Domestic Specimen Unit Analyses (In-Plant and Laboratory Specimens Tested)

	Monitoring	Exploratory	Surveillance		Individual Enforcement Testing		Totals	
	Lab	Lab	In-Plant	Lab	In-Plant	Lab	In-Plant	Lab
Antibiotics	8,510	---	---	9,000	---	---	---	17,510
STOP	---	---	---	---	124,461[1,2]	4,808[3]	124,461[1,2]	4,808[3]
CAST	---	---	11,833[1]	---	---	---	111,833[1]	---
Sulfonamides	8,330	---	---	9,000	---	---	---	17,330
SOS	---	---	105,091[1]	696[3]	---	---	105,091[1]	696[3]
Alachlor[4]	---	1,500	---	---	---	---	---	1,500
Arsenic	2,400	---	---	---	---	---	---	2,400
Diminazene Aceturate (Berenil)[4]	---	1,670	---	---	---	---	---	1,670
Carbadox	---	---	---	800	---	---	---	800
CHC/COP's	9,410	---	---	---	---	---	---	9,410
Clenbuterol[4]	---	1,900	---	---	---	---	---	1,900
Halofuginone	600	---	---	---	---	---	---	600

1 Estimates are based on 1992 residue data.

2 All STOP in-plant tests will also be tested for sulfonamides.

3 Expected laboratory confirmatory analysis of in-plant positive tests based on 1992 residue data.

4 Exploratory project.

TABLE VI: 1994 Domestic Specimen Unit Analyses (In-Plant and Laboratory Specimens Tested), continued

	Monitoring	Exploratory	Surveillance		Individual Enforcement Testing		Totals	
	Lab	Lab	In-Plant	Lab	In-Plant	Lab	In-Plant	Lab
ivermectin	3,900	---	---	---	---	---	---	3,900
Levamisole	3,900	---	---	---	---	---	---	3,900
Morantel tartrate	2,400	---	---	---	---	---	---	2,400
Totals	**39,450**	**5,070**	**216,924**	**19,496**	**124,461**	**4,808**	**341,385**	**68,824**

Sum Total: 410,209

TABLE VII: 1994 Domestic Monitoring Specimen Unit Analyses: Livestock

	Horses	Bulls	Beef Cows	Dairy Cows	Heifers	Steers	Bob Calves	Formula Fed Calves	Non-formula Calves	Heavy Calves	Sheep	Lamb	Goats	Market Hogs	Boars	Sows
Antibiotics Total: 6,120	---	300	480	480	300	300	480	480	480	480	300	300	480	300	480	480
Sulfonamides Total: 5,940	---	300	480	480	300	300	480	480	480	480	300	300	300	300	480	480
Arsenic Total: 1,200	---	---	---	---	---	---	---	---	---	---	---	---	300	300	300	300
CHC/COPs Total: 7,020	300	480	480	480	480	480	---	480	480	480	480	480	480	480	480	480
Ivermectin Total: 3,900	---	---	300	300	300	300	---	300	300	300	300	300	300	300	300	300
Levamisole Total: 3,900	---	300	300	300	300	300	---	300	---	300	300	300	300	300	300	300
Morantel tartrate Total: 2,400	---	300	300	300	300	300	---	300	300	300	---	---	---	---	---	---
Totals	**300**	**1,680**	**2,340**	**2,340**	**1,980**	**1,980**	**960**	**2,340**	**2,040**	**2,340**	**1,680**	**1,680**	**2,160**	**1,980**	**2,340**	**2,340**

Sum Total: 30,480

TABLE VIII: 1994 Domestic Monitoring Specimen Unit Analyses: Poultry and Rabbits

	Chickens Young	Chickens Mature	Turkeys Young	Turkeys Mature	Ducks	Geese	Rabbits
Antibiotics Total: 2,390	480	480	480	480	300	70	100
Sulfonamides Total: 2,390	480	480	480	480	300	70	100
Arsenic Total: 1,200	300	300	300	300	---	---	---
CHC/COPs Total: 2,390	480	480	480	480	300	70	100
Halofuginone Total: 600	300	---	300	---	---	---	---
Totals	**2,040**	**1,740**	**2,040**	**1,740**	**900**	**210**	**300**

Sum Total: 8,970

TABLE IX: 1994 Estimated Import Specimen Unit Analyses

	Beef	Pork	Beef/ Pork	Veal	Mutton/ Lamb	Goat	Chicken	Turkey	Duck/Goose/ Guinea Fowl
Antibiotics Total: 3,068	1,251	1,154	---	131	170	80	152	70	60
Sulfonamides Total: 7,299	2,500	2,308	684	543	420	120	384	199	141
Arsenic Total: 1,055	---	772	---	---	---	---	152	71	60
CHC/COP's Total: 4,993	1,600	1,538	458	300	335	90	380	171	121
Halofuginone Total: 222	---	---	---	---	---	---	152	70	---
Ivermectin Total: 1,919	800	768	---	131	170	50	---	---	---
Levamisole Total: 1,312	500	461	---	131	170	50	---	---	---
Morantel tartrate Total: 631	500	---	---	131	---	---	---	---	---
Totals	**7,151**	**7,001**	**1,142**	**1,367**	**1,265**	**390**	**1,220**	**581**	**382**

Sum Total: 20,499

TABLE X: 1994 Estimated Import Specimen Unit Analyses Per Country

	Beef	Pork	Beef/Pork	Veal	Mutton/ lamb	Goat	Chicken	Turkey	Duck/Goose/ Guinea Fowl
Argentina Total: 243	243	---	---	---	---	---	---	---	---
Australia Total: 4,600	3,122	41	16	333	752	336	---	---	---
Belgium Total: 128	---	128	---	---	---	---	---	---	---
Brazil Total: 94	94	---	---	---	---	---	---	---	---
Canada Total: 8,164	1,179	4,294	264	508	56	----	1,128	401	334
Costa Rica Total: 185	145	---	---	40	---	---	---	---	---
Croatia Total: 55	16	39	---	---	---	---	---	---	---
Czechoslovakia Total: 24	---	24	---	---	---	---	---	---	---
Denmark Total: 2,193	---	1,594	599	---	---	---	---	---	---

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TABLE X: 1994 Estimated Import Specimen Unit Analyses Per Country, continued

	Beef	Pork	Beef/Pork	Veal	Mutton/ lamb	Goat	Chicken	Turkey	Duck/Goose/ Guinea Fowl
Dominican Republic Total: 63	63	---	---	---	---	---	---	---	---
Finland Total: 56	16	40	---	---	---	---	---	---	---
France Total: 96	---	32	16	---	---	---	24	---	24
Germany Total: 40	---	24	16	---	---	---	---	---	---
Great Britain Total: 24	---	---	---	---	---	---	---	24	---
Guatemala Total: 67	67	---	---	---	---	---	---	---	---
Honduras Total: 137	137	---	---	---	---	---	---	---	---
Hong Kong Total: 133	---	---	---	---	---	---	24	109	---

TABLE X: 1994 Estimated Import Specimen Unit Analyses Per Country, continued

	Beef	Pork	Beef/Pork	Veal	Mutton/ Lamb	Goat	Chicken	Turkey	Duck/Goose/ Guinea Fowl
Hungrary Total: 213	---	197	16	---	---	---	---	---	---
Iceland Total: 32	---	---	---	---	32	---	---	---	---
Ireland Total: 72	---	72	---	---	---	---	---	---	---
Israel Total: 115	---	---	---	---	---	---	44	47	24
Italy Total: 48	16	32	---	---	---	---	---	---	---
Japan Total: 16	16	---	---	---	---	---	---	---	---
Mexico Total: 72	48	24	---	---	---	---	---	---	----
Netherlands Total: 373	---	192	181	---	---	---	---	---	---
New Zealand Total: 2,723	1,837	24	---	470	338	54	---	---	---

TABLE X: 1994 Estimated Import Specimen Unit Analyses Per Country, continued

	Beef	Pork	Beef/Pork	Veal	Mutton/ lamb	Goat	Chicken	Turkey	Duck/Goose/ Guinea Fowl
Nicaragua Total: 62	62	---	---	---	---	---	---	---	---
Poland Total: 139	---	123	16	---	---	---	---	---	---
Romania Total: 32	---	32	---	---	---	---	---	---	---
Slovenia Total: 24	---	24	---	---	---	---	---	---	---
Sweden Total: 123	48	41	18	16	---	---	---	---	---
Switzerland Total: 40	16	24	---	---	---	---	---	---	---
Uruguay Total: 113	26	---	---	---	87	---	---	---	---
Totals	**7,151**	**7,001**	**1,142**	**1,367**	**1,265**	**390**	**1,220**	**581**	**382**

Sum Total: 20,499

TABLE XI: Estimated Annual Volume of Imported Beef

	Estimated Total Poundage	Fresh Product (lbs)	Processed Product (lbs)
Argentina	115,305,890	---	115,305,890
Australia	807,322,000	807,000,000	322,000
Brazil	44,737,000	---	44,737,000
Canada	310,290,000	301,399,000	8,891,000
Costa Rica	33,954,000	33,678,000	276,000
Croatia	171,000	---	171,000
Dominican Republic	13,570,000	13,570,000	---
Finland	260,000	260,000	---
Guatemala	15,173,000	15,173,000	---
Honduras	35,349,000	35,349,000	---
Italy	57,000	---	57,000
Japan	12,000	12,000	---
Mexico	1,005,000	1,000,000	5,000
New Zealand	474,397,000	472,754,000	1,643,000
Nicaragua	13,500,000	13,500,000	---
Sweden	3,467,000	3,461,000	6,000
Switzerland	26,000	---	26,000
Uruguay	12,750,000	---	12,750,000
Totals	**1,881,345,890**	**1,697,156,000**	**184,189,890**

TABLE XII: 1994 Imported Beef Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Antibiotics F	Sulfonamides F/P	CHC/COP's F /P	Ivermectin F	Levamisole F	Morantel Tartrate F
Argentina Total: 243	---	149	94	---	---	---
Australia Total: 3,122	588	1,050	663	371	225	225
Brazil Total: 94	---	58	36	---	---	---
Canada Total: 1,179	220	400	252	139	84	84
Costa Rica Total: 145	25	51	35	16	9	9
Croatia Total: 16	---	8	8	---	---	---
Dominican Republic Total: 63	10	18	11	8	8	8
Finland Total: 16	---	8	8	---	---	---
Guatemala Total: 67	11	20	12	8	8	8
Honduras Total: 137	26	46	29	16	10	10
Italy Total: 16	---	8	8	---	---	---

TABLE XII: 1994 Imported Beef Specimen Unit Analyses for Fresh (F) and Processed (P) Product, continued

	Antibiotics F	Sulfonamide F/P	CHC/COP's F/P	Ivermectin F	Levamisole F	Morantel Tartrate F
Japan Total: 16	---	8	8	---	---	---
Mexico Total: 48	8	8	8	8	8	8
New Zealand Total: 1,837	345	619	391	218	132	132
Nicaragua Total: 62	10	17	11	8	8	8
Sweden Total: 48	8	8	8	8	8	8
Switzerland Total: 16	---	8	8	---	---	---
Uruguay Total: 26	---	16	10	---	---	---
Totals	**1,251**	**2,500**	**1,600**	**800**	**500**	**500**

Sum Total: 7,151

TABLE XIII: Estimated Annual Volume of Imported Pork

	Estimated Total Poundage	Fresh Product (lbs)	Processed Product (lbs)
Australia	2,635,000	2,635,000	---
Belgium	9,550,000	---	9,550,000
Canada	425,889,000	371,669,000	54,220,000
Croatia	2,350,000	---	2,350,000
Czechoslovakia	34,000	---	34,000
Denmark	138,491,000	70,177,000	68,314,000
Finland	1,908,000	1,908,000	---
France	224,000	---	224,000
Germany	70,000	---	70,000
Hungary	14,613,000	---	14,613,000
Ireland	1,221,000	616,000	605,000
Italy	865,000	---	865,000
Mexico	15,000	---	15,000
Netherlands	14,270,000	---	14,270,000
New Zealand	48,000	48,000	---
Poland	9,160,000	---	9,160,000
Romania	852,000	---	852,000
Slovenia	72,500	---	72,500
Sweden	2,566,000	2,566,000	---
Switzerland	47,000	---	47,000
Totals	**624,880,500**	**449,619,000**	**175,261,500**

TABLE XIV: 1994 Imported Pork Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Antibiotics F	Sulfonamides F/P	Arsenic F/P	CHC/COP's F/P	Ivermectin F	Levamisole F
Australia Total: 41	---	9	8	8	8	8
Belgium Total: 128	62	34	10	22	---	---
Canada Total: 4,294	353	1,521	453	987	619	361
Croatia Total: 39	15	8	8	8	---	---
Czechoslovakia Total: 24	---	8	8	8	---	---
Denmark Total: 1,594	445	495	148	321	117	68
Finland Total: 40	---	8	8	8	8	8
France Total: 32	8	8	8	8	---	---
Germany Total: 24	---	8	8	8	---	---
Hungary Total: 197	95	52	16	34	---	---
Ireland Total: 72	8	16	16	16	8	8
Italy Total: 32	8	8	8	8	---	---
Mexico Total: 24	---	8	8	8	---	---

TABLE XIV: 1994 Imported Pork Specimen Unit Analyses for Fresh (F) and Processed (P) Products

	Antibiotics F	Sulfonamides F/P	Arsenic F/P	CHC/COP's F/P	Ivermectin F	Levamisole F
Netherlands Total: 192	93	51	15	33	---	---
New Zealand Total: 24	---	8	8	8	---	---
Poland Total: 123	59	33	10	21	---	---
Romania Total: 32	8	8	8	8	---	---
Slovenia Total: 24	---	8	8	8	---	---
Sweden Total: 41	---	9	8	8	8	8
Switzerland Total: 24	---	8	8	8	---	---
Totals	**1,154**	**2,308**	**772**	**1,538**	**768**	**461**

Sum Total: 7,001

TABLE XV: 1994 Imported Beef/Pork Specimen Unit Analyses for Processed (P) Product

	Est. annual Imports (lbs)	Sulfonamides P	CHC/COP's P
Australia Total: 16	14,000	8	8
Canada Total: 264	2,996,000	160	104
Denmark Total: 599	6,807,000	364	235
France Total: 16	154,000	8	8
Germany Total: 16	68,000	8	8
Hungary Total: 16	50,000	8	8
Netherlands Total: 181	2,065,000	110	71
Poland Total: 16	37,000	8	8
Sweden Total: 18	189,000	10	8
Totals	**12,379,000**	**684**	**458**

Sum Total: 1,142

TABLE XVI: 1994 Imported Veal Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Est. annual Imports (lbs)	Antibiotics F	Sulfonamides F/P	CHC/ COP's F	Ivermectin F	Levamisole F	Morantel Tartrate F
Australia Total: 333	9,249,000	---	149	79	35	35	35
Canada Total: 508	10,007,000	131	169	94	38	38	38
Costa Rica Total: 40	93,000	---	8	8	8	8	8
New Zealand Total: 470	12,983,000	---	209	111	50	50	50
Sweden Total: 16	3,000	---	8	8	---	---	---
Totals	**32,335,000**	**131**	**543**	**300**	**131**	**131**	**131**

Sum Total: 1,367

TABLE XVII: 1994 Imported Mutton/Lamb Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Est. Annual Imports (lbs)	Antibiotics F	Sulfonamides F/P	CHC/COP's F/P	Ivermectin F	Levamisole F/P
Australia Total: 752	35,812,000	52	271	211	109	109
Canada Total: 56	15,000	8	16	16	8	8
Iceland Total: 32	35,000	---	8	8	8	8
New Zealand Total: 338	14,885,000	39	117	92	45	45
Uruguay Total: 87	63,000	71	8	8	---	---
Totals	**50,810,000**	**170**	**420**	**335**	**170**	**170**

Sum Total: 1,265

TABLE XVIII: 1994 Imported Goat Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Est. Annual Imports (lbs)	Antibiotics F	Sulfonamides F/P	CHC/ COP's F/P	Ivermectin F	Levamisole F
Australia Total: 336	4,298,00	70	104	78	42	42
New Zealand Total: 54	650,000	10	16	12	8	8
Totals	**4,948,000**	**80**	**120**	**90**	**50**	**50**

Sum Total: 390

TABLE XIX: 1994 Imported Chicken Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Est. Annual Imports (lbs)	Antibiotics F/P	Sulfonamides F	Arsenic F/P	CHC/ COP's F/P	Halofuginone F
Canada Total: 1,128	5,738,000	152	350	128	346	152
France Total: 24	1,000	---	8	8	8	---
Hong Kong Total: 24	129,000	---	8	8	8	---
Israel Total: 44	302,000	---	18	8	18	---
Totals	**6,170,000**	**152**	**384**	**152**	**380**	**152**

Sum Total: 1,220

TABLE XX: 1994 Imported Turkey Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Est. Annual Imports (lbs)	Antibiotics F	Sulfonamides F/P	Arsenic F/P	CHC/COP's F/P	Halofuginone F
Canada Total: 401	2,308,000	70	120	39	102	70
Great Britain Total: 24	1,000	---	8	8	8	---
Hong Kong Total: 109	964,000	---	50	16	43	--
Israel Total: 47	398,000	---	21	8	18	---
Totals	**3,671,000**	**70**	**199**	**71**	**171**	**70**

Sum Total: 581

TABLE XXI: 1994 Imported Duck/Goose/Guinea Fowl Specimen Unit Analyses for Fresh (F) and Processed (P) Product

	Est. Annual Imports (lbs)	Antibiotics F	Sulfonamides F/P	Arsenic F/P	CHC/COP's F/P
Canada Total: 334	1,565,000	60	125	44	105
France Total: 24	47,305	---	8	8	8
Israel Total: 24	22,900	---	8	8	8
Totals	**1,635,205**	**60**	**141**	**60**	**121**

Sum Total: 382

Section 2

1994 RESIDUE LIMITS

Introduction

This section provides information on residue limits in meat and poultry products applied by FSIS (as of July 1, 1993). These limits include tolerances and action levels developed by the Environmental Protection Agency (EPA) for pesticide chemicals, and by the Food and Drug Administration (FDA) for animal drugs and unavoidable contaminants. These limits are derived in most cases from the Code of Federal Regulations (CFR): pesticide limits from 40 CFR 180, those for animal drugs from 21 CFR 556, and unavoidable contaminants from 21 CFR 109. The approved use conditions for animal drugs can be found in 21 CFR 520, 522, 524, 526, 529 (new animal drugs not subject to certification), 540, 544, 546, 548 (antibiotic drugs for use with animals), and 558 (new animal drugs for use in animal feed).

Formal tolerances are not established in all cases. For example, tolerance exemptions have been granted by FDA and EPA in approving the use of some pesticides and new animal drugs. For some unavoidable contamination situations, FDA and EPA, upon request, recommend action levels to FSIS; however, tolerances or action levels have not been established for all such situations. FSIS permits concentrations of residues in meat and poultry that do not exceed the residue limits published in this section.

The residue limits for poultry and livestock species are listed alphabetically by compound (which may include a compound's metabolites). The entries include, among other things, CFR or Federal Register (FR) citations for tolerances, and notations of action levels. Entries for animal drugs with "zero" or "no residue" tolerances also include, in parenthesis, the limits of quantification. These limits are used by FDA for enforcement purposes, and are applied by FSIS in determining if product is adulterated. A dash (-) indicates no tolerances have been established.

Any residue of a new animal drug found in the edible tissues of a species for which the drug is not approved will be considered an adulterant, provided the residue is found at a concentration that can be quantified and confirmed by a validated analytical method. A concentration of a substance endogenous in the animal tissue in question would not be considered an adulterant.

Unless otherwise indicated, "meat byproducts" includes kidney and liver.

1994 RESIDUE LIMITS

Compound	Reference	Cattle	Sheep/ Goats	Swine	Poultry
		Units are parts per million			
ANTIBIOTICS					
Chloramphenicol	21 CFR 520.390	0(0.25)Et[1] ppb	0(0.25)Et[1] ppb	-	-
Chlortetracycline	21 CFR 556.150	0F[2] 0.1K[2] 0.1L[2] 0.1M[2]	- 1K[3] 0.5L[3] 0.1M[3]	0.2F 4K 2L 1M	1F 4K 1L 1M, 1S
Erythromycin	21 CFR 556.230 58 FR 43795	0(0.3)Et[1]	-	0.1Et	0.125Et
Gentamicin sulfate	21 CFR 556.300	-	-	0.4F 0.4K 0.3L 0.1M	0.1Et[4]
Neomycin	21 CFR 556.430 21 CFR 522.1484 21 CFR 524.1484	0.25Et[5] 1.00F[6] 0.75K[6] 0.50L[6] 0.25M[6]	- 1.25F[6] 1.25K[6] 1.25L[6] 0.25M[6]	- 1.00F[6] 1.00K[6] 0.75L[6] 0.25M[6]	- 0.50F[6] 1.00K[6] 0.75L[6] 0.25M[6]
Oxytetracycline	21 CFR 556.500 58 FR 42855	0.1Et	0.1Et	0.1Et	1F 3K 1L 1M 1S

1 Numbers in parenthesis are minimum levels of detection.
2 Cattle only; calves 1F, 4K 4L, 1M.
3 Sheep only.
4 Turkeys only.
5 Calves only.
6 Action level (letter from J. Taylor of FDA to L. Crawford of FSIS, January 26, 1988).

KEY

Ek:Excluding kidneys	M:Muscle
Et:Edible tissue	Mb:Meat byproducts
F:Fat	S:Skin
K:Kidney	Sf:Skin with fat
L:Liver	Sm:Skeletal muscle

1994 RESIDUE LIMITS

Compound	Reference	Cattle	Sheep/ Goats	Swine	Poultry
		Units are parts per million			
ANTIBIOTICS, continued					
Penicillin	21 CFR 556.510	0.05Et	0(0.04)Et[1]	0(0.04)Et[1]	0(0.04)Et[1,2]
Streptomycin	21 CFR 556.610 58 FR 4721	2K[3] 0.5Et[3]	-	0.02K 0.5Et	0.2K 0.5Et
Tetracycline	21 CFR 556.720	0.25Et[3]	0.25Et	0.25Et	0.25Et
Tylosin	21 CFR 556.740	0.2F 0.2K 0.2L 0.2M	-	0.2F 0.2K 0.2L 0.2M	0.2F 0.2K 0.2L 0.2M
SULFONAMIDES					
Sulfachlorpyridazine	21 CFR 556.630	0.1Et[3]	-	0.1Et	-
Sulfadimethoxine	21 CFR 556.640	0.1Et	-	-	0.1Et
Sulfaethoxy-pyridazine	21 CFR 556.650 MPI Dir. 917.1	0.1Et	-	0(0.1)Et[1]	-
Sulfamethazine	21 CFR 556.670	0.1Et	-	0.1Et	0.1Et[4]
Sulfathiazole	21 CFR 556.690	-	-	0.1Et	-
ALACHLOR and metabolites	40 CFR 180.249	0.02F 0.02M 0.02Mb	0.02F 0.02M 0.02Mb	0.02F 0.02M 0.02Mb	0.02F 0.02M 0.02Mb

1 Numbers in parenthesis are minimum levels of detection.
2 Chickens, pheasants, and quail; turkeys 0.01Et; ducks and geese 0.01Et (action level).
3 Calves only.
4 Chickens and turkeys.

KEY

Ek:Excluding kidneys	M:Muscle
Et:Edible tissue	Mb:Meat byproducts
F:Fat	S:Skin
K:Kidney	Sf:Skin with fat
L:Liver	Sm:Skeletal muscle

1994 RESIDUE LIMITS

Compound	Reference	Cattle	Sheep/ Goats	Swine	Poultry	Horses
		Units are parts per million				
ARSENICALS						
Arsenic	21 CFR 556.60	-	-	2K 2L 0.5M 0.5Mb	0.5M 2Mb	
CARBADOX and metabolite	21 CFR 556.100	-	-	0(0.03)Et[1]	-	
CHLORINATED HYDROCARBONS & ORGANOPHOSPHATES (CHC/COP'S)						
Aldrin[2]	51 FR 46662	0.3F	0.3F	0.3F	0.3F	0.3F
Benzene Hexachloride[2] [BHC]	51 FR 25697	0.3F	0.3F	0.3F	0.3F	0.3F
Carbopheno-thion	40 CFR 180.156	0.1F	0.1F	0.1F	-	-
Chlordane[3]	51 FR 46665	0.3F	0.3F	0.3F	0.3F	0.3F
2-Chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate [chlorfenvinphos]	40 CFR 180.322	0.2F	0.2F	0.005F	0.005F	0.005F
2-Chloro-1-(2,4,5-tri chlorophenyl)vinyl dimethyl phosphate [stirofos]	40 CFR 180.252	1.5F	0.5F	1.5F	0.75F	0.5F

1 Numbers in parenthesis are minimum levels of detection.
2 Action level.
3 Action level; includes sum of residues of cis- and trans-chlordane, cis- and trans-nonachlor, oxychlordane (octachlor epoxide).

KEY

Ek:Excluding kidneys
Et:Edible tissue
F:Fat
K:Kidney
L:Liver
M:Muscle
Mb:Meat byproducts
S:Skin
Sf:Skin with fat.
Sm:Skeletal muscle

1994 RESIDUE LIMITS

Compound	Reference	Cattle	Sheep/ Goats	Swine	Poultry	Horses
CHC/COP'S, continued						
Chlorpyrifos and metabolite	40 CFR 180.342	2.0F 2.0M 2.0Mb	1.0F 1.0M 1.0Mb	0.5F 0.5M 0.5Mb	0.5F 0.5M 0.5Mb	1.0F 1.0M 1.0Mb
Coumaphos and oxygen analog	40 CFR 180.189	1F 1M 1Mb	1F 1M 1Mb	1F 1M 1Mb	1F 1M 1Mb	1F 1M 1Mb
DDT and metabolites[1]	51 FR 46658	5F	5F	5F	5F	5F
Dieldrin[1]	51 FR 46662	0.3F	0.3F	0.3F	0.3F	0.3F
Dodecachloroocta-hydro-1, 3, 4-metheno-2H-cyclo-buta(cd) pentalene [Mirex][1]	51 FR 45114	0.1F 0.1M 0.1Mb	0.1F 0.1M 0.1Mb	0.1F 0.1M 0.1Mb	0.1F 0.1M 0.1Mb	0.1F 0.1M 0.1Mb
Endosulfan and metabolite	40 CFR 180.182	0.2F 0.2M 0.2Mb	0.2F 0.2M 0.2Mb	0.2F 0.2M 0.2Mb	-	0.2F 0.2M 0.2Mb
Endrin[1]	MPI Dir 917.1	0.3F	0.3F	0.3F	0.3F	0.3F
Heptachlor and heptachlor epoxide[1]	54 FR 33690 MPI Dir 917.1	0.2F 0.2M 0.2Mb	0.2F 0.2M 0.2Mb	0.2F 0.2M 0.2Mb	0.2F 0.2M 0.2Mb	0.2F 0.2M 0.2Mb
Hexachloro-benzene [HCB][1]	MPI Dir 917.1	0.5F	0.5F	0.5F	0.5F	0.5F

1 Action level.

KEY

Ek:Excluding kidneys	M:Muscle
Et:Edible tissue	Mb:Meat byproducts
F:Fat	S:Skin
K:Kidney	SF:Skin with fat
L:Liver	Sm:Skeletal muscle

1994 RESIDUE LIMITS

Compound	Reference	Cattle	Sheep/ Goats	Swine	Poultry	Horses
		Units are parts per million				
CHC/COP'S, continued						
Lindane	40 CFR 180.133 MPI Dir. 917.1	7F	7F	4F	4F	7F
Linuron	40 CFR 180.184	1F 1M 1Mb	1F 1M 1Mb	1F 1M 1Mb	-	1F 1M 1Mb
Methoxychlor	40 CFR 180.120 MPI Dir 917.1	3F	3F	3F	3F[1]	3F
Polychlorinated[1,2] biphenyls [PCB's]	21 CFR 109.30 46 FR 39224	3F	3F	3F	3F	3F
Phosalone	40 CFR 180.263	0.25F 0.25M 0.25Mb	0.25F 0.25M 0.25Mb	0.25F 0.25M 0.25Mb	-	0.25F 0.25M 0.25Mb
Ronnel and metabolites	40 CFR 180.177	10F 4M 4Mb	10F 4M 4Mb	3F 2M 2Mb	0.01F 0.01M 0.01Mb	-

1 Action level.

2 The temporatory tolerances for unavoidable residues of PCB's in infant and junior foods are 0.2 ppm and 3 ppm respectively [21 CFR 109.30(a)(3,8)] residue of PCBs in infant and junior foods.

KEY

Ek:Excluding kidneys	M:Muscle
Et:Edible tissue	Mb:Meat byproducts
F:Fat	S:Skin
K:Kidney	Sf:Skin with fat
L:Liver	Sm:Skeletal muscle

1994 RESIDUE LIMITS

Compound	Reference	Cattle	Sheep/ Goats	Swine	Poultry
		Units are parts per million			
HALOFUGINONE	21 CFR 556.308 21 CFR 558.265	-	-	-	0.16L[1] 0.13L[1]
IVERMECTIN	21 CFR 556.344	15L[2]	30L[3]	20L[4]	-
LEVAMISOLE	21 CFR 556.350	0.1Et	0.1Et[5]	0.1Et	0.1Et
MORANTEL TARTRATE	21 CFR 556.425 21 CFR 520.1450 21 CFR 558.360	0.7L[6]	-	-	-

1 Broiler chickens and turkeys respectively; tolerance for parent halofuginone; corresponds to 0.3 ppm total residues in liver.
2 Tolerance in ppb for 22, 23 dihydroavermectin B1 a; corresponds to 50 ppb total residues in liver.
3 Sheep only; tolerance in ppb for 22, 23 dihydroavermectin B1a; corresponds to 125 ppb total residues in liver.
4 Tolerance in ppb for 22, 23-dihydroavermectin B1 a; corresponds to 75 ppb total residues in liver.
5 Sheep only.
6 Tolerance for marker residue N-methyl--1,3-propanediamine (MAPA); corresponds to 2.4 ppm total residues in liver.

KEY

Ek:Excluding kidneys	M:Muscle
Et:Edible tissue	Mb:Meat byproducts
F:Fat	S:Skin
K:Kidney	Sf:Skin with fat
L:Liver	Sm:Skeletal muscle

Section 3

FSIS RESIDUE ANALYTICAL CAPABILITY

Introduction

The Food Safety and Inspection Service (FSIS) requires practical analytical methods for detecting, quantifying, and identifying all residues that may be present in meat, poultry, and their processed products at levels above established safe residue limits. These methods can be used by the Agency for monitoring, surveillance, and individual enforcement activities to determine whether product is adulterated. The Agency uses available methodology to take appropriate regulatory action against adulterated products, consistent with the reliability of the analytical data. However, because of the large number of potential residues that may occur in the food chain, practical methods are not available for many compounds of interest.This section describes the types of methods used by FSIS to conduct analyses and their suitability for regulatory use. A list of key terms precedes the method descriptions.

Method Levels

Methods are described in terms of levels of use:

Level I -- These are assays with the highest level of credibility. They are unequivocal at the level of interest. They may be single procedures that determine both the concentration and the identity of the analyte, or combinations of determinative methods for concentration and confirmatory methods for definitive identification.

Level II -- These are assays that are not unequivocal but are used to determine the concentration of an analyte at the level of interest and to provide some structural information. These methods are reliable enough to be used as reference methods.

Level III -- These are screening methods that may generate limited though useful information. These tests detect the presence or absence of a compound or a class of compounds at some concentration level of interest. They are used because of a greater throughput, portability, or convenience than the Level I or Level II methods. The level of reliability has been determined and documented. The hallmark of Level III tests is that action based on individual positive results requires substantiation based on Level I or Level II methods, as required by the uncertainty of any individual results.

Methods are further classified according to their status. Within each classification, subgroups are defined according to the extent to which a method was subjected to study. Therefore, whether (or how well) a specific analytical method meets a defined suitability criterion determines its classification and subgroup.

FSIS RESIDUE ANALYTICAL CAPABILITY
Criteria for Practical Methods

The following criteria have been identified as guidelines for methods suitable for regulatory use.

1. The method requires no more than 2-4 hours of analytical time per sample.

2. The method requires no instrumentation not customarily available in a laboratory devoted to trace drug or environmental analysis.

3. Chemical methods have a Minimum Proficiency Level (MPL) at or below the established residue limit and antimicrobial methods have a Minimum Inhibitory Concentration (MIC) at or below the established residue limit.

4. A quality assurance plan (QAP) has been developed for the method.

5. The method has been subjected successfully to an interlaboratory study at 0, 1/2 X, X, and 2X, where X is the analyte concentration at the residue limit. FSIS considers the methods described for "zero tolerance" compounds to be suitable for regulatory use if they meet the suitability criteria listed above and have an MPL or MIC at the operational definition of zero defined by FDA or EPA. Methods determined to be suitable for regulatory use except for criterion 3 or 5 will be marked with an asterisk (*). In an emergency situation, exceptions to a method's suitability may be necessary.

Method Status

The method status classifications are:

A. AOAC Official Methods. Such methods have been subjected to an interlaboratory study in which five or more laboratories participated. If this collaborative process provides results that establish acceptability, the methods are accepted as official methods by the AOAC. Some AOAC official methods have been subsequently studied for extension as follows:

1. Extension to other analytes, tissues, species, and products by a three-analyst (two or three laboratory) study - a validation study.

2. Extension by a one or two analyst intralaboratory or interlaboratory study as follows:

a. Extended to other tissues, species, and products for the initial analyte(s) studied.

b. Extended to other similar analytes in the same matrices as initially studied.

B. Validated Methods. Methods subjected to an interlaboratory study in two or three laboratories with a minimum of three independent analysts. The resulting data are reviewed by a peer group of government scientists. The data that result from the study are made available for review upon request. Included in this category would be post-1973 New Animal Drug Application (NADA) methods developed by sponsors that have been successfully studied by FSIS and FDA laboratories. Some validated methods have been subsequently studied for extension by a single or two analyst intralaboratory or interlaboratory study as follows:

1. Extended to other tissues, species, and products for the initial analyte(s) studied.

2. Extended to other similar analytes for the initial tissues/species and products studied.

C. Federal Register Methods. Methods of analysis published in the Federal Register and later incorporated into the Code of Federal Regulations.

D. Historical Official Methods. Methods that were considered to be the best available at the time of initial acceptance and have continued in use over an extended period in the absence of a more effective method. Included in this category would be pre-1974 NADA methods that were submitted by sponsors and accepted by FDA and FSIS without a multilaboratory study.

E. Nonvalidated Methods (NVM). Methods for quantification and/or confirmation that have not been subjected to a multilaboratory study of at least three independent analysts; or, analytical methods that have been subjected to a multilaboratory study but do not meet either criterion 3 or 5 of the criteria for methods suitable for routine use.

F. Published Methods. These methods have been subjected to a study by a single analyst or laboratory when the data for evaluation are limited. However, a quality control plan will be in place. The results are reviewed by a peer group of government scientists.

G. Correlated Methods. These methods have not been validated by traditional interlaboratory study, but data obtained from use of the method have been correlated and/or compared with data obtained from use of a method for regulatory enforcement. The same samples must be used for this comparison, and the data must be reviewed by a peer group of government scientists.

FSIS RESIDUE ANALYTICAL CAPABILITY

KEY TERMS

AAS -- Atomic absorption spectrometry

AOAC -- Association of Official Analytical Chemists

CELIA CA -- Competitive Enzyme Labeled Immunoassay for Chloramphenicol: a laboratory test that detects and identifies chloramphenicol residues in cattle and pork muscle

EC -- Electron capture

EI -- Electron impact

E-Z Screen -- A proprietary immunoassay system for rapidly detecting and identifying various antibiotics and other residues in tissues extracts

CITE™ -- Sulfa Trio Test (IDEXX) A proprietary immunoassay system for rapidly detecting and identifying sulfamethazine, sulfathiazole and sulfadimethoxine in tissue extracts

GC -- Gas chromatography

GLC -- Gas liquid chromatography

GPC -- Gel permeation chromatography

HFB -- heptafluorobutyrl[imidazole]

HPLC -- High pressure liquid chromatography

JAOAC -- Journal of the Association of Official Analytical Chemists

J. Food Prot. -- Journal of Food Protection

LDL -- Lowest detectable limit: the smallest amount of individual residue or sample component that can be reliably observed or found in the sample matrix by the current appropriate methodology

LRC -- Lowest recoverable concentration

Method Status -- See discussion above

FSIS RESIDUE ANALYTICAL CAPABILITY

KEY TERMS

MIC -- Minimum inhibitory concentration: the minimum level of antimicrobial compound present in a buffer extract of tissue that will inhibit bacterial growth

MPL -- Minimum proficiency level: the minimum amount of analyte expected to be identified and quantified by a laboratory and upon which ongoing capability will be evaluated. It is the smallest concentration for which the predicted coefficient of variation for reproducibility (CV) is less than or equal to 20 percent and the upper 90 percent confidence level for the predicted CV is less than 30 percent

MS -- Mass spectrometry

NADA -- New Animal Drug Application, issued by the Food and Drug Administration (FDA)

NE -- Level not established

NICI -- Negative ion chemical ionization

PICI - Positive ion chemical ionization

PP -- Processed product

Quantification -- The determination of the amount of residue present in a sample

Reference Methods -- Analytical procedures by which other methods may be evaluated and for which performance standards are established. These methods are considered suitable for regulatory use in the National Residue Monitoring Program

Residue -- Any compound present in edible tissues of the target animal that results from that compound's use or inadvertent introduction into the animal. "Residue" includes the compound itself, its metabolites, and other substances formed in or on food because of the compound's use or inadvertent introduction

SOS -- Sulfa-on-Site: a rapid in-plant chemical screening test for detecting sulfonamide residues in food animal urine or serum that provides same-day results

STOP -- Swab Test on Premises: an overnight in-plant microbiological screen test for detecting antibiotic residues in edible tissues

FSIS RESIDUE ANALYTICAL CAPABILITY

KEY TERMS

Swab -- STOP precursor: an overnight laboratory microbiological screen test for detecting antibiotic residues in edible tissues

TLC -- Thin layer chromatography

UV -- Ultraviolet spectrophotometric technique for detection and quantification

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	LDL/ MIC	MPL	TEST METHOD Level/ Status	Species/ Tissues	Reference
ANTIBIOTICS						
Chloramphenicol	Tissue extracts are screened by E-Z screen	25 ppb	NE	IIE	Cattle, Swine/ muscle, kidney	Environmental Diagnostics
Chlortetracycline	Antibiotic screen test (Swab): ability of tissue fluids containing anti-microbial activity to inhibit microbial growth	0.01 ppm	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831
	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	0.01 ppm	NE	IID	All/kidney liver muscle	Sec. 6.312 FSIS Microbiology Lab Guidebook
	Extraction using C18 columns followed by HPLC with UV detection	0.15 ppm	0.25 ppm	IIE	All/kidney liver muscle	Copy available upon request
Erythromycin	Antibiotic screen test (Swab): ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	25 ppb	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Erythromycin continued	Microbiological assay procedure: ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	25 ppb	NE	IID	All/kidney liver muscle	Sec. 6.316 FSIS Microbiology Lab Guidebook
Gentamicin sulfate	Tissue extracts are screened by E-Z Screen	50 ppb	NE	IIIE	All/muscle liver kidney	Environmental Diagnostics
	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	NE	NE	IIB	Swine/kidney	NADA 103-037& 91-191 Schering
	Extraction followed by detection by HPLC with fluorescence detector	0.2 ppm	0.4 ppm	IB	Swine/kidney	GEN FSIS Chemistry Lab Guidebook Hoechst
Neomycin sulfate	Tissue is deproteinized, acidified, and extracted; quantified by HPLC/UV	1.5 ppm	NE	IIB	All/kidney	Validation sponsored by FDA Center for Veterinary Medicine; copy available

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Neomycin sulfate continued	Antibiotic screen test (Swab): ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	0.25 ppm	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831
	Tissue extracts are screened by E-Z Screen	50 ppb	NE	IIIE	All/muscle liver kidney	Environmental Diagnostics
	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	0.25 ppm	NE	IID	All/kidney liver muscle	Sec. 6.317 FSIS Microbiology Lab Guidebook
Oxytetracycline hydrochloride	Antibiotic screen test (Swab): ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	0.08 ppm	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831
	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	0.08 ppm	0.08 ppm	IID	All/kidney liver muscle	Sec. 6.312 FSIS Microbiology Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	LDL/ MIC	MPL	TEST METHOD Level/ Status	Species/ Tissues	Reference
Oxytetracycline hydrochloride continued	Extraction using C18 columns followed by HPLC with UV detection	0.15 ppm	0.25 ppm	IIE	All/kidney liver muscle	Copy available upon request
Penicillins (benzathine, free acid, sodium salt, and procaine salts)	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	12.5 ppb	NE	IID	All/kidney liver muscle	Sec. 6.311 FSIS Microbiology Lab Guidebook
Streptomycin	Antibiotic screen test (Swab): ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	0.25 ppm	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831
	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	0.25 ppm	NE	IID	All/kidney liver muscle	Sec. 6.315 FSIS Microbiology Lab Guidebook
Tetracycline	Antibiotic screen test (Swab): ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	0.08 ppm	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Tetracycline continued	Microbiological assay procedure: ability of tissue extracts containing antimicrobial activity to inhibit microbial growth	0.08 ppm	NE	IID	All/kidney liver muscle	Sec. 6.312 FSIS Microbiology Lab Guidebook
	Extraction using C18 columns followed by HPLC with UV detection	0.15 ppm	0.25 ppm	IIE	All/kidney liver muscle	Copy available upon request
Tylosin	Antibiotic screen test (Swab): ability of tissue fluids containing antimicrobial activity to inhibit microbial growth	0.20 ppm	NE	IIIE	All/kidney	J. Food Prot., 1981, 44, 828-831
	Tissue extracts are screened by E-Z screen	50 ppb	NE	IIIE	All/muscle liver kidney	Environmental Diagnostics
	Liquid-liquid extraction followed by HPLC-UV detection	0.1 ppm	NE	IIE	Cattle/muscle	Copy available upon request

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
SULFONAMIDES						
Sulfachlor-pyridazine	TLC fluorescence: tissue extracts are partitioned by TLC and quantified by densitometry	0.02 ppm	0.05 ppm	IIA-2b	Red meat liver muscle	SUL FSIS Chemistry Lab Guidebook
	Extraction followed by GC/EI/MS	0.05 ppm	NE	1B-2	Red meat liver muscle	SUL FSIS Chemistry Lab Guidebook
Sulfadimethoxine	TLC fluorescence: tissue extracts are partitioned by TLC and quantified by densitometry	0.02 ppm	0.05 ppm	IA	All/liver muscle	SUL FSIS Chemistry Lab Guidebook
	Extraction followed by GC/EI/MS	0.05	NE ppm	IB	All/liver muscle	SUL FSIS Chemistry Lab Guidebook
	Tissue extracts are screened by CITE Sulfa Trio	10 ppb	NE	IIIE	All/liver	IDEXX Corp.

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Sulfaethoxy-pyridazine	TLC fluorescence: tissue extracts are partitioned by TLC and quantified by densitometry	0.02 ppm	0.05 ppm	IIA-2b	Red meat liver muscle	SUL FSIS Chemistry Lab Guidebook
	Tissue extracts are confirmed by GC/EI/MS	0.05 ppm	NE	IB-2	Red meat liver muscle	SUL FSIS Chemistry Lab Guidebook
Sulfamethazine	TLC fluorescence: tissue extracts are partitioned by TLC and quantified by densitometry	0.02 ppm	0.05 ppm	IIA IIA-2a	All/liver muscle Red meat/ feed concentrate pp	SUL FSIS Chemistry Lab Guidebook
	Tissue extracts are confirmed by GC/EI/MS	0.05 ppm	NE	IB	All/liver muscle	SUL FSIS Chemistry
	Tissue extracts are detected by TLC fluorescence (SOS-urine)	NE	NE	IIIG	Swine/urine	Copy available upon request
	Tissue extracts are screened by CITE Sulfa Trio	10 ppb	NE	IIIE	All/liver	IDEXX Corp.

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Sulfathiazole	TLC fluorescence: tissue extracts are partitioned by TLC and quantified by densitometry	0.02 ppm	0.05 ppm	IIA-1	Red meat liver muscle	Sul FSIS Chemistry Lab Guidebook
	Tissue extracts are confirmed by GC/EI/MS	0.05 ppm	NE	IB	Red meat liver muscle pp	SUL FSIS Chemistry Lab Guidebook
	Extracts are screened by CITE Sulfa Trio	10 ppb	NE	IIIE	All/liver	IDEXX Corp.
ARSENICALS	Dry ashed tissue dissolved and reacted to produce arsine gas (A_sH_3), which reacts to form blue complex for colorimetric quantification	0.05 ppm	0.20 ppm	IIA	All/liver, kidney muscle	ARS FSIS Chemistry Lab Guidebook
CARBADOX	Tissue extract is hydrolyzed and a derivative is prepared and separated by ion exclusion chromatography, then quantified by GC-ECD	7.5 ppb	30 ppb	IIB	Swine/liver	CBX FSIS Chemistry Lab Guidebook
	Extracts confirmed by GC/EI/MS	3.0 ppb (LRC)	NE	IE	Swine/liver	CBX FSIS Chemistry

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
CHLORINATED HYDROCARBONS AND ORGANOPHOSPHATES (CHC/COP'S)						
Aldrin	Micro alumina assay: column chromatography plus GC	0.02 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC-ECD	0.02 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.02 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills confirmed by GC/MS	NE	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Benzene Hexachloride (BHC)	Micro alumina assay: column chromatography plus GC	0.30 ppm	0.50	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	Alpha isomer: GPC followed by GC-ECD	0.01 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Benzene Hexachloride (BHC) continued	Beta and delta isomers: GPC followed by GC-ECD	0.02 ppm	0.05 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.02 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills confirmed by GC/MS	0.01 ppm (LRC)	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Carbophenothion	Tissue extracts are quantified by GC with flame photometric or nitrogen-phosphorous flame ionization detector	0.10 ppm	NE	IIB	All/liver	ORP1 FSIS Chemistry Lab Guidebook
	GPC plus GC	0.03 ppm	0.20 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	GPC extracts are confirmed by CG/EI/MS	0.01 ppm	NE	IE	Red meat/fat	ORP2 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Chlordane	Micro alumina assay: column chromatography plus GC	0.30 ppm	0.50 ppm	IIE	All/fat	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC-ECD	0.10 ppm	0.30 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.15 ppm	0.30 ppm	IIB	All/fat	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills are confirmed by GC/MS	NE	NE	IE (GPC/MS) IF (Mills/MS)	All/fat	CHC4 FSIS Chemistry Lab Guidebook
Chlordecone (kepone)	GPC followed by GC-ECD	0.03 ppm	0.20 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	GPC extracts are confirmed by GC/EI/MS	NE	NE	IE	Poultry, red meat/fat	CHC4 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
2-Chloro-1-(2,4,-di-chlorophenyl) vinyl diethyl phosphate (chlorfenvinphos)	GPC followed by GC	0.03	0.10 ppm	IIA-2b ppm	Cattle, sheep/fat	CHC3 FSIS Chemistry Lab Guidebook
	GPC extracts are confirmed by GC/EI/MS	0.02 ppm (LRC) poultry 0.10 ppm (LRC) beef	NE	IE	Poultry, beef fat	ORP2 FSIS Chemistry Lab Guidebook
2-Chloro-1-(2,4, 5-tri-chlorophenyl) vinyl dimethyl phosphate (stirofos)	GPC followed by GC-ECD	0.05 ppm	0.30 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	GPC extracts are confirmed by GC/EI/MS	0.08 ppm (poultry) 0.10 ppm (beef)	NE	IE	Poultry,beef fat	ORP2 FSIS Chemistry Lab Guidebook
Chlorpyrifos	GPC followed by GC-ECD	0.05 ppm	0.20 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Chlorpyrifos continued	GPC extracts are confirmed by GC/EI/MS	0.05 ppm (poultry) 0.05 ppm (swine)	NE	IE	Poultry, swine fat	ORP2 FSIS Chemistry Lab Guidebook
Coumaphos and oxygen analog	GPC followed by GC-ECD	0.15 ppm	0.30 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	GPC extracts are confirmed by GC/EI/MS	0.20 ppm (LRC)	NE	IE	beef/fat	ORP2 FSIS Chemistry Lab Guidebook
DDE (metabolites of DDT collectively reported as DDT)	Micro alumina assay: column chromatography plus GC	0.20 ppm	0.50 ppm	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC-ECD	0.02 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GLC	0.02 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
DDE (metabolites of DDT collectively reported as DDT) continued	Extracts from GPC or Mills are confirmed by GC/MS	0.02 ppm (LRC)	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
DDT (isomers of DDT collectively reported as DDT)	Micro alumina assay: column chromatography plus GC	0.30 ppm	0.50 ppm	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	o,p, isomer: GPC followed by GC-ECD	0.04 ppm	0.15 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	p,p, isomer: GPC followed by GC-ECD	0.03 ppm	0.15 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method:Florisil column chromatography plus GC	0.04 ppm	0.15 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
TDE (metabolite of DDT reported as DDT)	Micro alumina assay: column chromatography plus GC	0.04 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.03 ppm	0.15 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.04 ppm	0.15 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills are confirmed by GC/MS	0.02 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Dieldrin	Micro alumina assay: column chromatography plus GC	0.01 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.01 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Dieldrin continued	Mills method: Florisil column chromatography	0.01 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills are confirmed by GC/MS	0.02 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Dodecachloro-octahydro-1, 3, -4, metheno-2H-cyclobuta(cd)-pentalene [Mirex]	Micro alumina assay: column chromatography plus GC	0.04 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.04 ppm	0.10 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.04 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills are confirmed by GC/MS	0.05 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Endosulfan I	GPC followed by GC	0.01 ppm	0.10 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	GPC extracts are confirmed by GC/EI/MS	0.02 ppm	NE	IE	Red meat/fat	ORP1 FSIS Chemistry
Endosulfan II	GPC followed by GC	0.02 ppm	0.20 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
Endrin	Micro alumina assay: column chromatography plus GC	0.03 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.03 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.03 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Endrin continued	Extracts from GPC or Mills are confirmed by GC/MS	0.05 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Heptachlor and heptachlor epoxide	Micro alumina assay: column chromatography plus GC	0.01 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC plus GC	0.01 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.01 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills are confirmed by GC/MS	0.02 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Hexachlorobenzene (HCB)	Micro alumina assay: column chromatography plus GC	0.01 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Hexachlorobenzene (HCB) continued	GPC followed by GC	0.01 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.01 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook
	Extracts from GPC or Mills are confirmed by GC/MS	0.01 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Lindane	Micro alumina assay: column chromatography plus GC	0.01 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.01 ppm	0.05 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.01 ppm	0.10 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Lindane continued	Extracts from GPC or Mills are confirmed by GC/MS	0.01 ppm	NE	IE (GPC/MS) IF (Mills/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Linuron	GPC followed by GC	0.25 ppm	0.50 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Extracts are confirmed by GC/EI/MS	0.05 ppm	NE	IE	Red meat fat	ORP2 FSIS Chemistry Lab Guidebook
Methoxychlor	Micro alumina assay: column chromatography plus GC	0.15 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.15 ppm	0.50 ppm	IIA	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Mills method: Florisil column chromatography plus GC	0.15 ppm	0.50 ppm	IIB	All/fat pp	CHC1 FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Methoxychlor continued	Extracts from GPC or Mills are confirmed	0.15 ppm	NE	IE (GPC/MS)	All/fat pp	CHC4 FSIS Chemistry Lab Guidebook
Polychlorinated biphenyls (PCB's) (reported as Aroclor 1242, 1248, 1254, 1260, etc.)	Micro alumina assay: column chromatography plus GC	0.30 ppm	NE	IIE	All/fat pp	CHC2 FSIS Chemistry Lab Guidebook
	GPC followed by GC	0.30 ppm	0.50 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
Phosalone	GPC followed by GC	0.01 ppm	0.05 ppm	IIA-2b	All/fat	CHC 3 FSIS Chemictry Lab Guidebook
	GPC extracts are confirmed by GC/EI/MS	0.02 ppm	NE	IE	Red meat fat	ORP 2 FSIS Chemistry Lab Guidebook
Ronnel	Tissue extracts are quantified by GC with flame photometric or nitrogen-phosphorous flame ionization detector	NE	NE	IIB	All/liver muscle	Copy available upon request

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
Ronnel continued	GPC followed by GC	0.02 ppm	0.05 ppm	IIA-2b	All/fat	CHC3 FSIS Chemistry Lab Guidebook
	Extracts are confirmed by GC/EI/MS	0.01 ppm (poultry)	NE	IE	Poultry, red meat fat	To be added to CHC4 FSIS Chemistry Lab Guidebook
		0.10 ppm (red meat)	NE			
CLENBUTEROL	Tissue extracts are quantified and Confirmed by GC/MS of the oxazolidone derivative	0.5 ppb	1.0 ppb	IE	Red meat/ liver musclel	Copy available upon request
DIMINAZENE ACETURATE (Berenil)	HPLC-UV absorption. Plasma prepared by Solid phase extraction	0.01 ppm	0.03 ppm	IIIE	Cattle/Plasma	Chromatography 276:218-223,1983
HALOFUGINONE	Tissue extracts are quantified by HPLC-UV	0.05 ppm	0.05 ppm	IIB muscle	Chicken/liver	HLF FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
HALOFUGINONE continued	Tissue extracts are confirmed by GC/MS/MS/	0.05 ppm	NE	IB	Chicken/liver muscle	NADA 130-951 American Hoechst
IVERMECTIN	Tissue extracts are quantified by HPLC fluorescence	2 ppb	5 ppb	IIB	Red meat liver muscle	IVR FSIS Chemistry Lab Guidebook
LEVAMISOLE	Tissue extracts are quantified by GC flame photometric detection	0.05 ppm	NE	IIE	Red meat liver muscle	Sec. 5.033 FSIS Revised Basic Chemistry Lab Guidebook pages 5-167 March 1986
	Tissue extracts are subjected to GC/MS	0.05 ppm	NE	IIE	Red meat liver muscle	LVM FSIS Chemistry Lab Guidebook

FSIS RESIDUE ANALYTICAL CAPABILITY

Compound	Description	TEST METHOD LDL/ MIC	MPL	Level/ Status	Species/ Tissues	Reference
MORANTEL TARTRATE	Tissue extract is hydrolyzed and a derivative is quantified by GC	0.25 ppm	0.50 ppm	IIB	Cattle/liver	MPT FSIS Chemistry Lab Guidebook
		0.50 ppm	NE	IIE	Cattle/muscle	
	Identification of a structurally significant hydrolyzed fragment by GC/MS	0.25 ppm	NE	IB	Cattle/liver muscle	NADA 92-444 NADA 93-903 Pfizer

National Residue Program Plan 1994

Residue Limits for 1994 Compounds

FSIS Residue Analytical Capability for 1994 Compounds